Fiberoptic Bronchoscopy (FOB)
Jesus Ramon Guajardo

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• No COI
• No other sources of funding

Objectives
by the end of this lesson...
1. Describe a Brief History and Definition of Fiberoptic Bronchoscopy (FOB)
2. Name the Differences between Rigid and Fiberoptic bronchoscopy
3. List the Indications for the Procedure
4. List the Benefits and risk associated with this procedure

History & Definition
• 1897 First bronchoscopy report.
  • Germany. Gustav Killian. FB Pork bone. Topical anesthesia.
• 1968-9 Fiberoptic bronchoscopy
• 1978 Reports on pediatric fiberoptic bronchoscopy
  • Gk "Bronkhos" → Windpipe &
  • Gk "Skopion" → to look at

FOB

Rigid Bronchoscopy
Method of choice for FB removal and airway procedures.
FOB: Great for dynamic assessment and obtaining BAL samples

1/8/2014
Training for FOB

- European Union Syllabus
  - 50 assists
  - 25 performs
  - >50 to get experience and confidence
- Training models: Inanimate and Animal
- France: “For a skilled operator, the duration of fiberoptic bronchoscopy does not exceed 2-3 minutes.”

Sedation and Anesthesia

- General anesthesia preferred in Peds
- Generally: OR provides better control
- Some centers utilize conscious sedation in PICU or other suitable other locations
- In the PICU patient monitoring and sedation by intensivist or general anesthesia suggested

Indications

Evidence Supported
- Respiratory symptoms in the immunocompromised
- Cystic Fibrosis
- PICU
- Persistent abnormal CXR
- Atelectasis is the most common indication in South America

Evaluation of

Other
- Persistent unexplained cough
- Unresponsive wheezing
- Further evaluation of persistent respiratory symptoms
- Evaluation of suspected airway anomalies
- Aspiration, Hemoptysis
- Other clinical indications
- Research

Contraindications

“The main contraindication to bronchoscopy is if it will provide no useful information”

Pneumonia in the Immunocompromised Host

- A line should be drawn somewhere
- For simple conditions, such as AOM, tympanocentesis indicated after two sequential treatment failures
- So, when is obtaining a pulmonary sample indicated in the immunocompromised host with pneumonia?
- Or in the patient with non-resolving pneumonia?

THE IMMUNOCOMPROMISED HOST
Pneumonia in the Immunocompromised Host

- Pulmonary complications are the leading cause of M&M
- Rapid and accurate dx is needed
- Impossible to make a definitive dx on clinical findings, CXR and CT scan

<table>
<thead>
<tr>
<th>Indication</th>
<th>FOB</th>
<th>Inf Isolated</th>
<th>Dx Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever/Neutropenia/RespSigns</td>
<td>45</td>
<td>23 (51%)</td>
<td>80%</td>
</tr>
<tr>
<td>Fever/Neutropenia/No RespSigns/CXR</td>
<td>7</td>
<td>7 (100%)</td>
<td>100%</td>
</tr>
<tr>
<td>RespSigns w/ No Fever</td>
<td>8</td>
<td>4 (50%)</td>
<td>88%</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>2</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>33 (53%)</td>
<td>84%</td>
</tr>
</tbody>
</table>

Fiberoptic Bronchoscopy, Efrati Ped Blood Cancer. 2007

Bronchoscopy

“It should not be forgotten that blind airway lavage may adequately answer many questions without the need for bronchoscopy”

Bronchoscopy in PICU

- Bronchoscopy with BAL in the PICU setting improves outcome or changes management in a significant percentage of patients
- Paper: 53 bronchs in NICU/PICU
  - 11 changed treatment
  - 20/23 atelectasis resolved or improved
  - 12 congenital airway malformations

Immunocompromised FOB Indications

- Acute onset of severe respiratory symptoms
- Insidious onset of cough and tachypnea
- HRCT (narrow slice width [1-2 mm]) inspiration/exhalation (“dynamic“)
  - Airway trapping in GVHD
  - "Tree in bud" appearance for Infection

Immunocompromised

- Pediatric anesthesiologist or skilled intensivist as patients may be on the verge of decompensation
- Platelets > 20-40 k
- Several bronchoalveolar lavages
  - One ml/kg aliquots (three to four times)
  - Different lobes. Target the affected one
    - RML
    - Lingula
    - Other

Fiberoptic Bronchoscopy, Efrati Ped Blood Cancer. 2007


Bronchoscopy in the PICU Setting
Bronchoscopy in PICU

- 103 Bronchs in PICU (mean age 4.7 years)
- 90% with abnormalities leading to change in therapy in 68 (66%) patients
- 20% with additional abnormalities not related to primary indication

Almost 25% change in management

“FOB should be seen as a routine diagnostic and therapeutic tool in PICU”

Bronchoscopy in PICU

Indications: Tubes

- Tube patency and position
- Obstructive lesions due to mechanical ventilation
  - Endobronchial Toilet
  - Atelectasis
  - Necrotizing Tracheobronchitis
- Selective Intubation
  - Bronchial intubation
  - Nasal intubation
  - Consider passing the ET tube into the oropharynx first

Indications: Pneumonia

- Bronchoscopy beats tracheal aspirates in VAP
  - More sensitive and specific
- Essential in the management of pneumonia in the immunocompromised host
  - Non-improving or deteriorating patient
  - Gram Neg organisms suspected

Pneumonia Table:

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>%</th>
<th>No. (%)</th>
<th>% Age</th>
<th>No. (%)</th>
<th>% Sedation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>155</td>
<td>(46%)</td>
<td>77%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Noisy Breathing</td>
<td>52</td>
<td>(16%)</td>
<td>85%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Cancer/PID</td>
<td>60</td>
<td>(18%)</td>
<td>84%</td>
<td>37%</td>
<td></td>
</tr>
<tr>
<td>CHD</td>
<td>51</td>
<td>(15%)</td>
<td>90%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Trauma</td>
<td>17</td>
<td>(5%)</td>
<td>85%</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>319</td>
<td>(100%)</td>
<td>79%</td>
<td>11%</td>
<td></td>
</tr>
</tbody>
</table>

“Almost 25% change in management”
Bronchoscopy in PICU
Indications: other pulm problems
Assessment of lobar/segmental collapse
• First treated with conventional physiotherapy
• Dornase (DNAase) inhaled and intratracheal
  anecdotally reported of benefit beyond CF (2.5
  mg in 10 cc NS)
• If the above fails, bronchoscopy may be
  indicated
Assessment of Focal Hyperexpansion
• Localized lesions may be found

Wheezing
• 113 children evaluated for unresponsive
  wheezing
48 % found with anomalies:
  – 34 % Malacia
  – 12 % FB
  – 2 % Vascular ring

FB
• Foreign Body Aspiration (FBA)
• 1027 children evaluated retrospectively
  – Age range 5 mo to 14 years, mean 17 mo
  – 53% with history of aspiration
  – Symptoms: paroxysmal cough (84%), followed by
    stridor, wheezing, fever, and dyspnea
  – CXR: 69% emphysema, 56% pneumonia, 13%
    atelectasis
• LF Tang wrote: Flexible bronchoscopy as first
  choice for FB removal!!

Acute Chest Syndrome
• Plastic bronchitis common in ACS (72%)
  – FOB was diagnostic but with questionable
    therapeutic benefits (Moser 2001)
• Pneumonia not very common (20%) (Kirkpatrick 1991)
• 44 % with pulmonary fat embolism (Vichinsky 1994)
COMPLICATIONS OF FOB

Complications

**Physiological**
- Hypoxia
- Hypercapnia
- Cardiac Arrhythmia & Bradys
- Laryngospasm
- Bronchosperm
- May worsen ventilation for many hours

**Mechanical**
- Epistaxis/nasal trauma
- Laryngeal trauma
- Subglottic edema
- Airway mucosal edema
- Hemoptysis (biopsy)
- Pneumothorax (biopsy)
- Introduction of infection

At least two fatalities have been reported.

Christus Santa Rosa
Pediatric Bronchoscopy

- Procedures performed in the GI suite
- Emergent Bronch → Contact Peds Pulm (210) 553 2941
- Most elective procedures scheduled through the pulm clinic in our patient population

Our Bronch Form

<table>
<thead>
<tr>
<th>Site of Biopsy</th>
<th>Type of Biopsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchial mucosa</td>
<td>Bronchial Secretions</td>
</tr>
<tr>
<td>Middle Bronchus</td>
<td>Nasal/Crural Washing</td>
</tr>
<tr>
<td>Middle Mediastinum</td>
<td>Vascular/lung biopsy</td>
</tr>
<tr>
<td>Lungs</td>
<td>Bronchial Mucosal Biopsy</td>
</tr>
<tr>
<td>Trachea</td>
<td>Bronchial Mucosal Biopsy/Thoracotomy</td>
</tr>
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</table>

Study/Laboratory:
- Cerebrospinal fluid (CFS)
- Serum
- Urine
- Saliva
- Nasal wash
- Tracheal aspirate
- Blood
- Bone marrow
- Stool
- Gastric juice
- Sputum
- Bronchial wash
- Bronchoalveolar lavage (BAL)
- Endotracheal aspirate
- Bronchial biopsy
- Throat swab
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- Tracheal aspirate
- Gastrointestinal biopsy
- Bone marrow
- Sputum
- Bronchial wash
- Bronchoalveo

Our Settings

**Sampling**

<table>
<thead>
<tr>
<th>Different areas</th>
<th>Different types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better to sample different areas than only one</td>
<td></td>
</tr>
<tr>
<td>Some protocols target RML and Lingula routinely followed by the most affected area</td>
<td></td>
</tr>
</tbody>
</table>

**Studies**

- Cell count and differential
  - Normal: Most cells are macrophages
  - Bacterial pneumonia, CF: Neutrophils
  - Viral, other lung diseases: lymphocytes
  - Asthma and other: eosinophils >1%

**Normal BAL**

**Lipid Laden Macrophages**

- Lipid and Hemosiderin Laden Macrophages
- Macrophages = “Trash Collectors”
- LLM
  - Many conditions, but aspiration should be considered if index high
  - Index calculated by # of macrophages + with Lipid in a 1 to 4 scale.
- HLM. Similar to LLM, but could be associated with pulmonary hemosiderosis.
  - Unexplained and recurrent pneumonia
Hemosiderin Laden Macrophages

Figure 4 - Sample of BAL fluid with hemosiderin-laden macrophages.

Studies

- Review by pathologist and stains (gram, AFB, Fungal, PCP)
- May provide very early diagnosis of many conditions
- Idea of what bacteria may need targeting
- Fungus in immunocompromised
- AFB for atypical myco or TB

Other

- Pneumocystis Jirovecii (carinii)
- Has been reported in patients with normal immune system (Nejmi 2010)
- Case report: acute and fulminant on a non-immunodeficient patient

LET'S REVIEW A CASE

4 yo boy

- Premature 26 week
- Multiple pneumonias
- Aggressive asthma/GERD treatment
- No major change in incidence of pneumonia
- Normal HRCT scan

So, what is going on with this boy? A case of bad asthma?

CXR: PBT with some hyperexpansion
Got sick again
• Returns with increased symptoms
• Increased RML findings

Questions
• For me?
• Now, for you! 😊

THANKS!